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TECHNICAL REPORT NO. 70-27

OPERATION OF THE TONTO FOREST SEISMOLOGICAL OBSERVATORY

Quarterly Report No. 2, Project VT/0704

Contract F33657-70-C-0733

1 April through 30 June 1970

TELEDYNE GEOTECH

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1 April through 30 June 1970

Sponsored by

Advanced Research Projects Agency
Nuclear Test Detection Office
ARPA Order No. 624

TELEDYNE GEOTECH
3401 Shiloh Road
Garland, Texas

27 July 1970

IDENTIFICATION

AFTAC Project No:	VELA T/0704
Project Title:	Operation of TFSO
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Effective Date of Contract:	1 January 1970
Amount of Contract:	$554,696
Contract Expiration Date:	30 June 1971
Program Manager:	B. B. Leichliter 271-2561, ext. 222

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* * * * * * * * *

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ABSTRACT

This is a report of the work accomplished on Project VT/0704 from 1 April through 30 June 1970. Project VT/0704 includes the operation, evaluation, and improvement of the Tonto Forest Seismological Observatory (TFSO) located near Payson, Arizona. It also includes special research and test functions carried out at TFSO and research and development tasks performed by the Garland, Texas, staff using TFSO data.

OPERATION OF THE TONTO FOREST SEISMOLOGICAL OBSERVATORY
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1. INTRODUCTION

1.1 AUTHORITY

The work described in this report was supported by the Advanced Research Projects Agency, Nuclear Test Detection Office, and was monitored by the Air Force Technical Applications Center (AFTAC) under Contract F33657-70-C-0733. The effective date of the contract is 1 January 1970; the Statement of Work for Project VT/0704 is included in the appendix to this report.

1.2 HISTORY

The Tonto Forest Seismological Observatory (TFSO) was constructed by the United States Corps of Engineers in 1963. TFSO was designed to record seismic events and to be used as a laboratory for testing, comparing, and evaluating advanced seismograph equipment and seismometric recording techniques. The instrumentation was assembled, installed, and operated until 30 April 1965 by the Earth Sciences Division of Teledyne Industries under Contract AF 33(657)-7747. On 1 May 1965, Geotech assumed the responsibility of operating TFSO. The location of TFSO is shown in figure 1.

2. OPERATION OF TFSO

2.1 GENERAL

Data are recorded at TFSO on a 24-hour day basis. Until 09 June 1970, the station was manned continuously. At this time, the midnight shift was discontinued leaving the station unmanned from 12:15 a.m. to 7:00 a.m. A full complement of personnel is on duty 8 hours per day, 5 days per week; at other times a reduced operating crew is on duty. No serious problems have occurred and the automatic emergency power system has performed satisfactorily during the times the station has been unmanned.

2.2 DEACTIVATION OF THE CROSS-LINEAR ARRAY

Recording of data from the cross-linear array was terminated on 09 June 1970, and the 37 short-period JM seismometers used in the array were removed from the field sites and stored in the warehouse. Spiral-4 cable is being picked up and tested on an "as time permits" basis. During June, 220 reels of cable were picked up. Many of these cables - 189 - tested bad because some pick-up work was conducted in areas where cables had not been removed when they failed

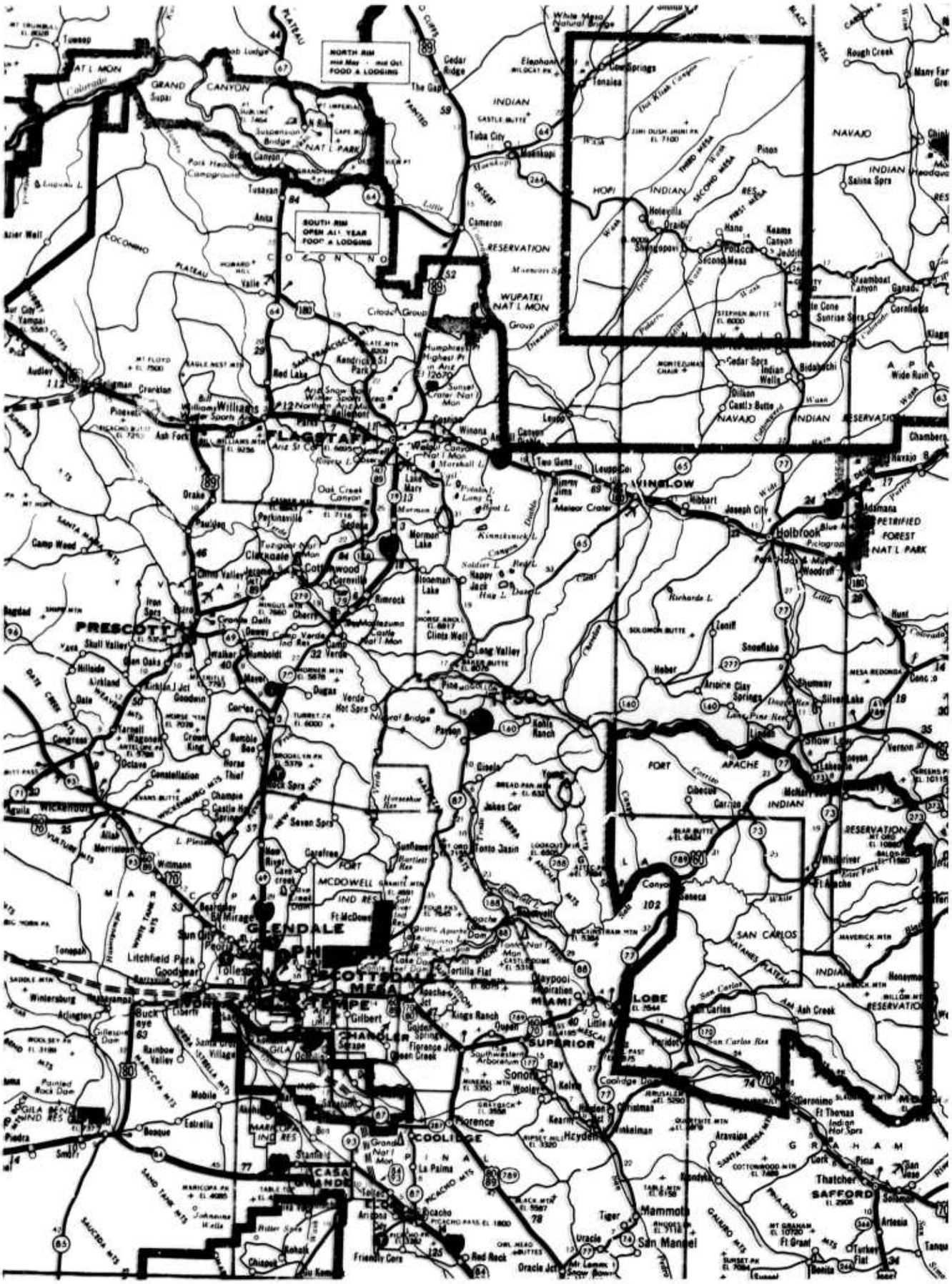


Figure 1. Location of TFSO

and circuits had been transferred to other cables. Some good cables that were used in the linear array were not removed, but were left to be used as spares for the 37-element array as needed.

Three Develocorders were taken off line when the recording of the linear array was terminated. These Develocorders will be used as spares and for recording of special tests.

2.3 STANDARD SEISMOGRAPH OPERATING PARAMETERS

The operating parameters and tolerances for the TFSO standard seismographs are shown in table 1. Frequency response tests are made routinely and parameters are checked and reset to maintain the specified tolerances.

Normalized response characteristics of TFSO standard seismographs are shown in figure 2. In addition to these standard seismographs, two filtered summation seismographs were operated until 09 June 1970.

2.4 DATA CHANNEL ASSIGNMENTS

Each data format recorded at TFSO is assigned a Data Group number. When a data format is changed, a new Data Group number is assigned. Several Data Format Change Notices reporting changes in channel assignments were submitted to the Project Officer and to frequent users of the TFSO data during this report period.

2.5 COMPLETION AND SHIPMENT OF DATA

Six analog FM magnetic-tape units are used to record data for the AFTAC (VELA Seismological Center (VSC)). Tapes from these units are sent weekly to our Garland, Texas, laboratory for quality control and are shipped from Garland to SDL about 15 days after the end of the month in which they were recorded.

From 14 April through May, daily shipments were made from TFSO to SDL of all ASDAS digital tapes, except two per week that were sent to the Garland laboratory. After the laboratory completed quality control inspections, the tapes were sent to SDL. During the remainder of this report period, all ASDAS tapes, except those sent to Garland for quality control, were held at the observatory for a period of about eight weeks and then were recycled if not requested by a data user.

All Develocorder (16-mm film) seismograms, except quality control copies, were routinely shipped to SDL. One seismogram from each Develocorder was sent each week to the Garland, Texas, laboratory for quality control, then forwarded to SDL.

Copies of calibration and operational logs accompanied all data shipments.

Table 1. Operating parameters and tolerances of standard seismographs at TFSO

Seismograph				Operating parameters and tolerances				Filter settings		
System	Comp	Type	Model	Ts	λs	Tg	λg	Model	Bandpass at 3 dB cutoff (sec)	Cutoff rate at SP side (dB/oct)
SP[a]	Z	Johnson-Matheson	6480	1.25 ±2%	0.54 ±5%	---	---	2888-1	0.2 - 1.0	6
SP[b]	Z	Johnson-Matheson	6480	1.25 ±2%	0.54 ±5%	0.33 ±5%	0.65 ±5%	6824-1	0.1 - 100	12
SP[b]	H	Johnson-Matheson	7515	1.25 ±2%	0.54 ±5%	0.33 ±5%	0.65 ±5%	6824-1	0.1 - 100	12
SP	Z	Benioff	1051	1.0 ±2%	1.0 ±5%	0.2 ±5%	1.0 ±5%	6824-1	0.1 - 100	12
SP	H	Benioff	1101	1.0 ±2%	1.0 ±5%	0.2 ±5%	1.0 ±5%	6824-1	0.1 - 100	12
SP	Z	UA Benioff	1051	1.0 ±2%	1.0 ±5%	0.75 ±5%	1.0 ±5%	---	---	--
BB	Z	Press-Ewing	SV-282	12.5 ±5%	0.45 ±5%	0.64 ±5%	9.0 ±5%	6824-7	0.05- 100	12
LP	Z	Geotech	7505A	20.0 ±5%	0.77	---	---	30024	80 - 300	6
LP	H	Geotech	8700C	20.0 ±5%	0.77	---	---	30024	80 - 300	6

KEY

SP Short period
IB Intermediate band
LP Long period
UA Unamplified (i.e., earth powered)
BB Broad band

Ts Seismometer free period (sec)
Tg Galvanometer free period (sec)
λs Seismometer damping constant
λg Galvanometer damping constant

[a]37-element hexagonal array

[b]Linear array and 3 comp (Deactivated 09 June 1970)

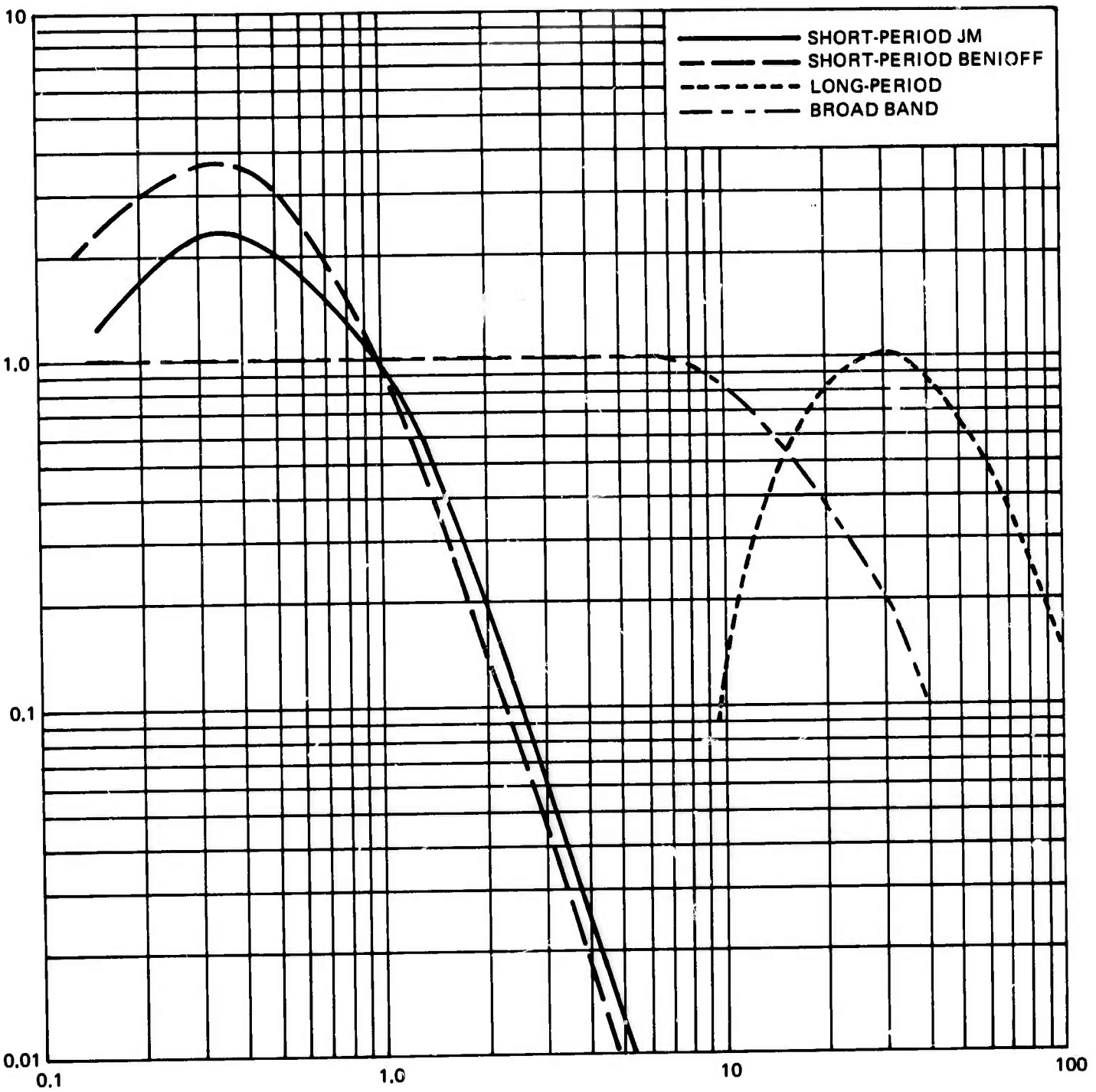


Figure 2. Normalized response characteristics of standard seismographs at TFSO

G 5048

2.6 QUALITY CONTROL

2.6.1 Quality Control of 16-mm Film Seismograms

Until 09 May 1970, quality control checks of randomly-selected 16-mm film seismograms from Data Trunks 1, 2, and 8 and the associated logs were made in Garland. Beginning 09 May 1970, seismograms from Data Trunk 4 have been checked in place of those from Data Trunk 1. Items that are routinely checked by the quality control analyst include:

a. Film boxes - neatness and completeness of box markings;

b. Develocorder logs - completeness, accuracy, and legibility of logs;

c. Film -

(1) Quality of the overall appearance of the record (for example, trace spacing and trace intensity);

(2) Quality of film processing;

d. Analysis - completeness, legibility, and accuracy of analysis sheets.

Results of these evaluations were sent to the observatory for their review and comment.

2.6.2 Quality Control of Analog FM Magnetic-Tape Seismograms

Each week, quality control checks of three randomly-selected magnetic-tape seismograms are made in Garland and at TFSO to assure the recordings meet specified standards. The following items are checked:

a. Tape and box labeling;

b. Accuracy, completeness, and neatness of logs;

c. Adequate documentation of logs by voice comments on tape where applicable;

d. Seismograph polarity;

e. Level of the microseismic background noise;

f. Level of calibration signals;

g. Relative phase shift between array seismographs;

h. Level of system noise;

i. Oscillator alignment;

j. Quality of recorded WWV signal where applicable;

k. Time-pulse carrier;

l. Binary-coded digital time marks.

2.6.3 Quality Control of Digital Magnetic-Tape Seismograms

Quality control checks of digital tapes are made routinely. At present, one tape from each of the two transports is checked weekly for the following items:

a. Neatness and accuracy of the associated logs;

b. Parity errors;

c. Recording level of each channel;

d. Fidelity of reproduction;

e. Presence of header record and correct record length.

2.7 SECURITY INSPECTION

Mr. Michael L. Craig, Chief, Office of Industrial Security, DCASD, Phoenix, Arizona, conducted a security inspection at TFSO on 27 May 1970. No deficiencies were found during the inspection. Mr. Craig later stated in a letter that the TFSO security procedures and controls are well in accord with current Industrial Security Manual requirements.

2.8 DEFENSE CONTRACT ADMINISTRATION

The quarterly small business report for January through March 1970 was submitted on 21 April 1970 to Mr. C. P. Fink, Special Assistant for small business of the Defense Contract Administration Service District (DCASD) in Phoenix, Arizona.

A request was received 28 April 1970 to also submit the report to the Department of Defense. Our Garland, Texas, office has been submitting this report and effective for quarterly report ending in June will be processed and submitted to Mr. Fink's office by our Garland office.

2.9 INVENTORY OF GOVERNMENT PROPERTY

2.9.1 TFSO Inventory

Copies of TFSO inventory lists and copies of DD 1149 forms that transfer TFSO property from Contract C-0803 to C-0733 were sent to Mr. L. R. Madden, Industrial Property Management, DCASD, Phoenix, Arizona, on 04 May 1970.

2.9.2 Transfer of Property from UBSO to TFSO

Government property shipped from UBSO, including a Kennedy recorder, three field stations, and related components, was received at TFSO on 11 April 1970. Four other field stations from UBSO were received on 30 June 1970.

2.9.3 Transfer of Property from WMSO to TFSO

A shipment of government property from WMSO included both equipment and components and was received at TFSO on 09 June 1970.

2.9.4 Sale of Government Residual Property

Invitations to bid were sent to 14 dealers for approximately six-hundred 1/4-mile sections of unusable Spiral-4 cable. Five responses were received, and the goods were sold to Mr. F. Hodish, Capital Metals, Phoenix, Arizona, who submitted a high bid of $626.57.

2.10 EMERGENCY POWER GENERATOR

The 100 kW standby generator, diesel power unit, Caterpillar, Model 59825, was operated a total of 7.8 hours during this report period - 0.4 hours were due to commercial power loss and 7.4 hours for tests under full load.

2.11 RESTORATION OF FOREST LAND

Restoration of sites in the 31-element array was continued on an "as time permits" basis, and work was completed at two sites during the report period. To date, work has been completed at a total of 22 sites in the 31-element array.

During this report period, fences at six sites in the 37-element array were rebuilt to comply with Forest Service regulations. The original fences at these sites had deteriorated and were permitting cattle within the vault area. To date, fences have been completed at 24 sites in the 37-element array.

2.12 FACILITY MAINTENANCE

The TFSO facilities were maintained in accordance with sound industrial procedures throughout the report period. This work included pest extermination, fire extinguisher inspection, work area cleaning, and repairs to the office air conditioning and heating equipment.

2.13 DEVELOCORDER OPERATION AND MAINTENANCE

2.13.1 Develocorder Retrofit Program

Work on five Develocorders was completed during the report period. Eleven of the twelve Develocorders at TFSO have been renovated to date.

2.13.2 Develocorder Pump Maintenance Procedures

Since January 1970, all Develocorder pump repairs have been conducted in the maintenance shop instead of the operations area. Pumps have been removed from Develocorders as they failed and have been replaced with operational spares. This procedure has lessened congestion in the operations area and has permitted better maintenance to be performed. As a result, the average time between pump failures has been increased from less than 60 days to more than 90 days.

2.14 DAMAGE TO GOVERNMENT PROPERTY

In compliance with new Industrial Security regulations, intentional damage to six Spiral-4 cables during April was reported to Mr. M. Craig, Chief, Industrial Security, DCASD, Phoenix, Arizona. The cables were damaged by cutting, hacking with rocks, and shooting. The damage was also reported to the F.B.I., Phoenix.

2.15 REMOVAL OF HIGHWAY SIGNS

The signs beside Arizona State Highway No. 160 that indicated the location of TFSO were removed by the State Highway Department on 29 May 1970. This action has greatly reduced the number of tourists who have attempted to visit the observatory.

3. EVALUATE DATA AND DETERMINE OPTIMUM OPERATIONAL CHARACTERISTICS

3.1 SHORT-PERIOD ARRAY

3.1.1 Lightning Protection

Four amplifiers and two line driver cards were damaged during the nine lightning storms that occurred during this reporting period.

The annual check of lightning protection circuits used at the observatory was completed during the report period. All AEI protectors were replaced with proven units and the ones removed were sent to Garland and were tested for acceptable performance. In addition, the resistance of grounding circuits was measured and found acceptably low at all sites.

3.1.2 Solid-State Amplifiers

During this report period, the output circuits of two amplifiers were modified to increase their output carrier levels. To date, 35 of the 43 amplifiers at TFSO have been modified.

3.1.3 Spiral-4 Cable Replacement

During the report period, 13 quarter-mile sections of Spiral-4 cable were replaced in the 37-element array. All these cables were damaged by electrical storms.

Eight other damaged cables were spliced and sealed. These exhibited clearly-defined areas of damage. Three had been cut by County Maintenance men, one by an unknown vehicle, and four by vandals.

3.2 LONG-PERIOD SEISMOGRAPH ARRAY

3.2.1 Lightning Protection

The nine known electrical storms that occurred during this report period caused no damage to the long-period array seismographs.

AEI lightning protectors were replaced at all sites within the long-period array.

Modifications to the long-period amplifiers, which involved removal of the 0.1 mfd capacitor from the power converter, were completed during April.

3.2.2 Circuit Changes by Mountain States Telephone Company (MST)

On 28 May, MST installed new carrier equipment in the LP2 data circuit and rerouted the cable to this terminal so that it would cross Forest Service land instead of private land. On 18 June, MST installed new carrier equipment in the LP3 data circuit. Data and calibration levels have been good and no outages have been experienced since the changes were made.

3.3 ASTRODATA SEISMIC DATA ACQUISITION SYSTEM

3.3.1 Recording Format

The recording format of the ASDAS was changed from number 18 to number 19 on 02 April 1970, and recording using that format has continued throughout the report period. Table 2 shows the data channels assigned to format 19.

Table 2. Astrodata seismic data acquisition system format 19

Channel	Data	Channel	Data
1	Z1	25	Z25
2	Z2	26	Z26
3	Z3	27	Z27
4	Z4	28	Z28
5	Z5	29	Z29
6	Z6	30	Z30
7	Z7	31	Z31
8	Z8	32	Z32
9	Z9	33	Z33
10	Z10	34	Z34
11	Z11	35	Z35
12	Z12	36	Z36
13	Z13	37	Z37

Table 2. Astrodata seismic data acquisition system format 19, continued

Channel	Data	Channel	Data
14	Z14	38	Z1LP
15	Z15	39	Z2LP
16	Z16	40	Z3LP
17	Z17	41	Z4LP
18	Z18	42	Z5LP
19	Z19	43	Z6LP
20	Z20	44	Z7LP
21	Z21	45	ZXLP
22	Z22	46	BS9
23	Z23	47	FSH
24	Z24	48	STS

3.3.2 Defective Tapes

The visual inspections of tapes for wrinkles and oxide scratches found 11 (about 1.4% of those checked) defective tapes during this report period.

3.3.3 Miscellaneous Repairs

All malfunctions that occurred during the report period were repaired with equipment on hand and included replacement of motor brushes, capstan drive belts, contacts, vacuum motors, and photosense lamps.

Head alignment was checked each month.

4. ANALYZE DATA

The arrival time, period,and peak amplitude of events recorded at TFSO are reported daily to the Director of the Environmental Science Service Administration Coast and Geodetic Survey in Washington, D. C.

The number of events reported by TFSO during each month of the reporting period is shown in table 4.

Table 3. Events reported to the C&GS by TFSO for April, May, & June

Month	Local	Near regional	Regional	Teleseisms	Total
April	1	61	11	1110	1183
May	3	93	6	881	983
June	4	50	10	804	868

Since 09 June, when the crossed-linear array operation was discontinued, analysis has been accomplished without the use of a high-gain flag trace that was produced by simply summing and filtering output from selected elements of that array. Instead, data from the Z60 system and beam-steered outputs from the MCF are used for analysis. Together, they have proven effective as flag traces. Figures 3, 5, and 7 are seismograms that exhibit the response of the Z60 system to low level teleseismic events. Figures 4,6, and 8 are seismograms that exhibit MCF responses to the same signals.

5. PROVIDE OBSERVATORY FACILITIES AND ASSISTANCE TO OTHER ORGANIZATIONS

5.1 TELEMETRY TO MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Transmission of seven channels of seismic data from TFSO via telephone circuits for the Lincoln Laboratories, Massachusetts Institute of Technology was discontinued on 05 June 1970.

5.2 UNIVERSITY OF UTAH

TFSO has continued to send copies of the daily station messages to Dr. Kenneth Cook, University of Utah.

5.3 BLUE MOUNTAIN SEISMOLOGICAL OBSERVATORY

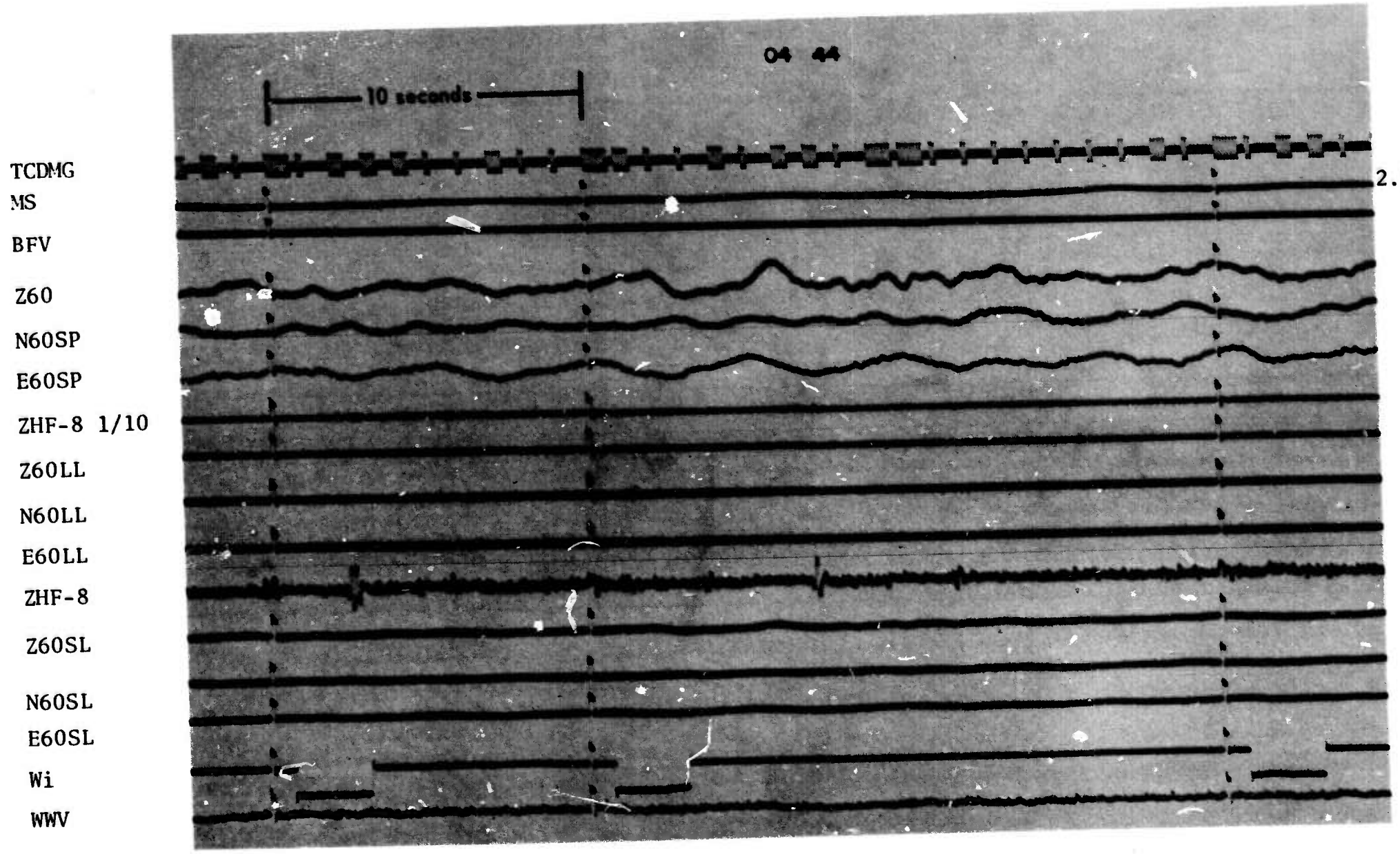
TFSO sent copies of the daily station message to BMSO until 08 June. At their request, no messages have been sent since that date.

5.4 LUKE AIR FORCE BASE, ARIZONA

Major Biddle, Luke AFB, Arizona, called on 14 April 1970 and requested information concerning a fighter jet crash in which a pilot lost his life on 10 April. The crash occurred about 15 miles NNW of TFSO. The approximate origin time of the crash and print of seismograms exhibiting the recording of the signal produced by the crash were furnished to Major Biddle.

5.5 UNIVERSITY OF CALIFORNIA, SAN DIEGO

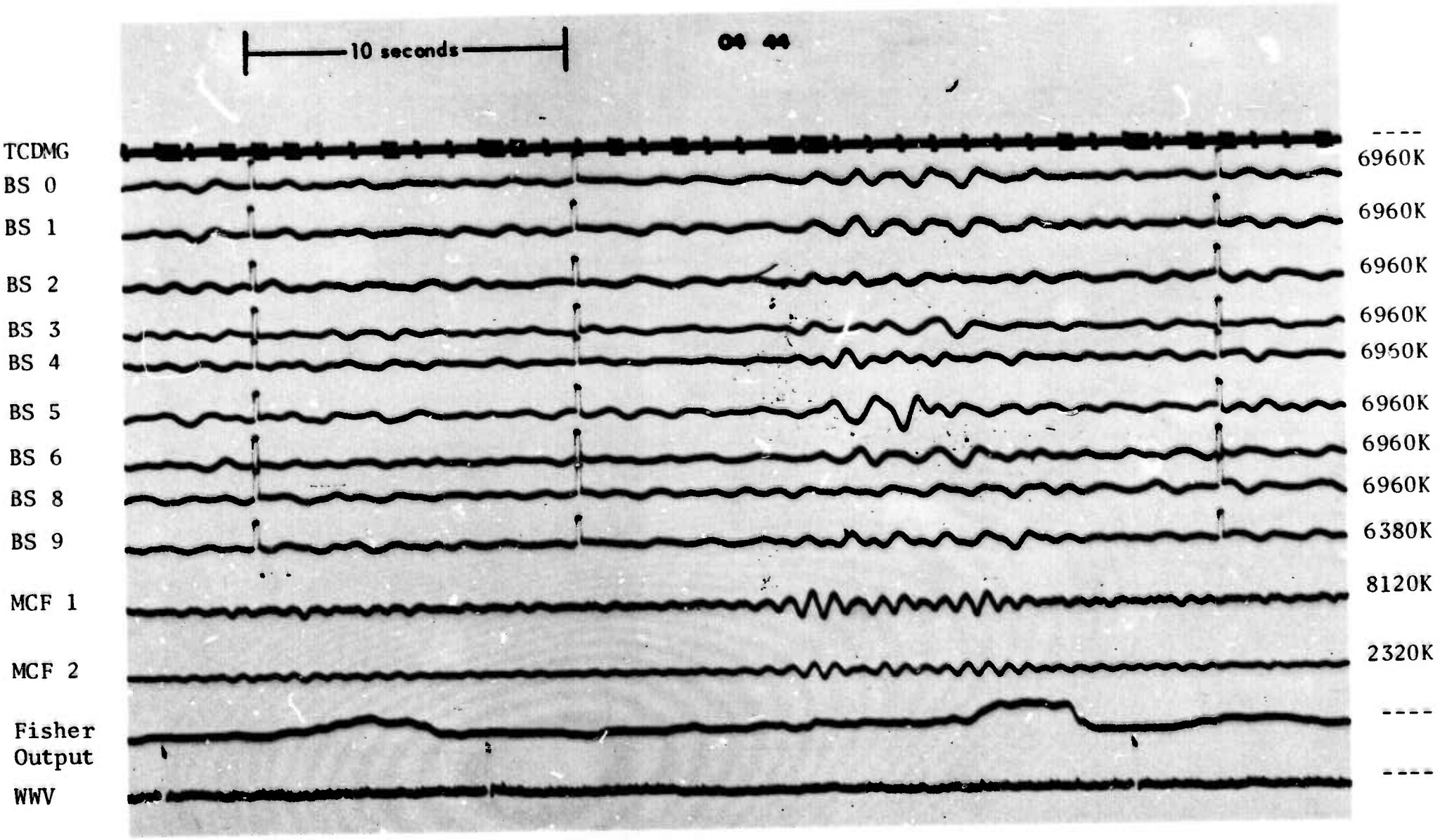
University of California, San Diego representatives, Mr. Bill Farrell and Mr. Don Miller visited TFSO several times during this report period to collect data and to maintain their instruments. Recently, Mr. Van Sice visited TFSO to deactivate and remove some of their equipment. The remainder was left at TFSO on a stand-by status.



TFSO
15 June 1970
70-166

Dev. 6
Data Trunk 4
Data Group 7296

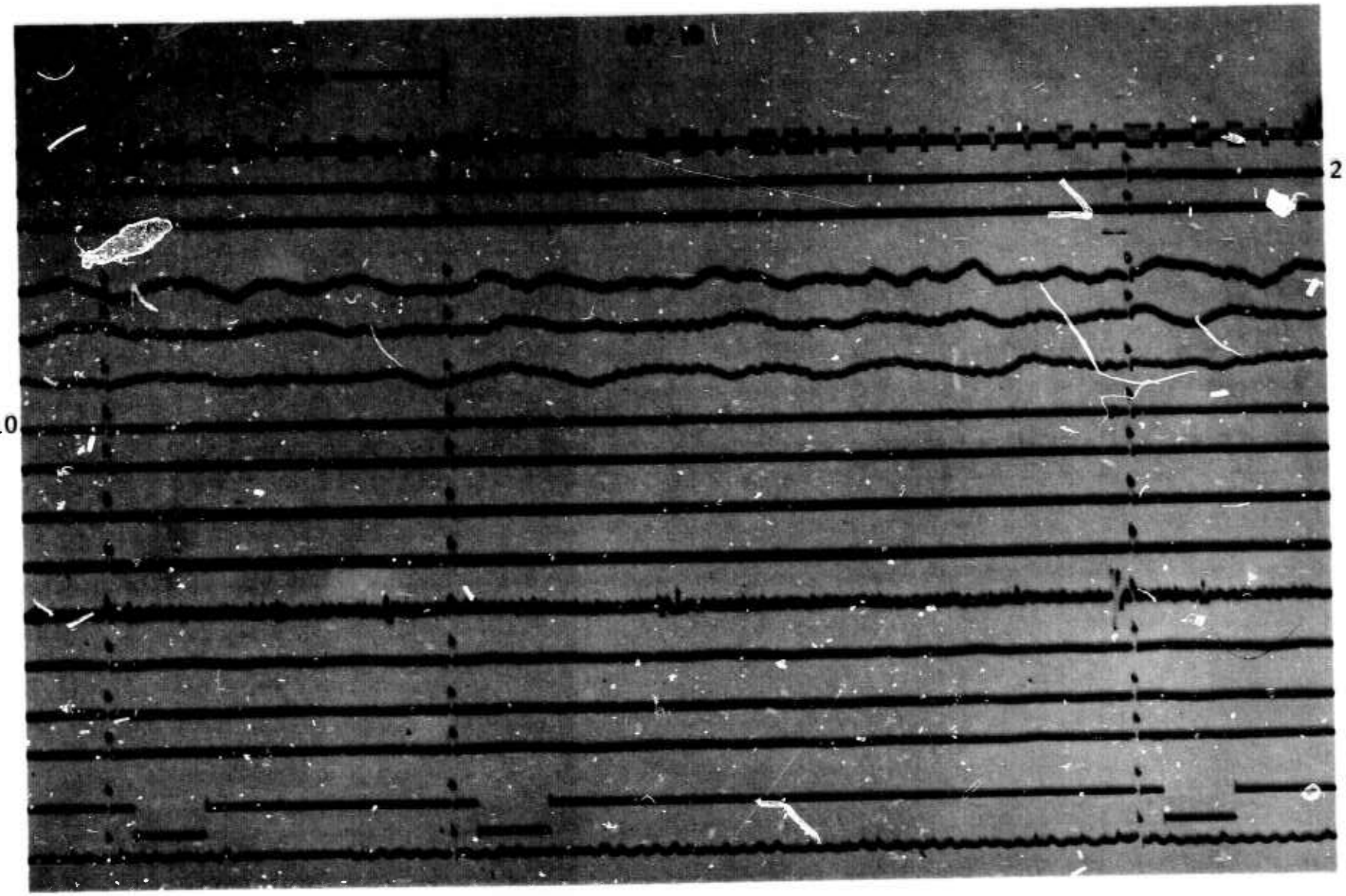
Figure 3. Short-period seismogram exhibiting response of SPZ60 seismograph to a low-level teleseismic event of unknown epicenter



TFSO
15 June 1970
70-166

Dev. 7
Data Trunk 6
Data Group 7294

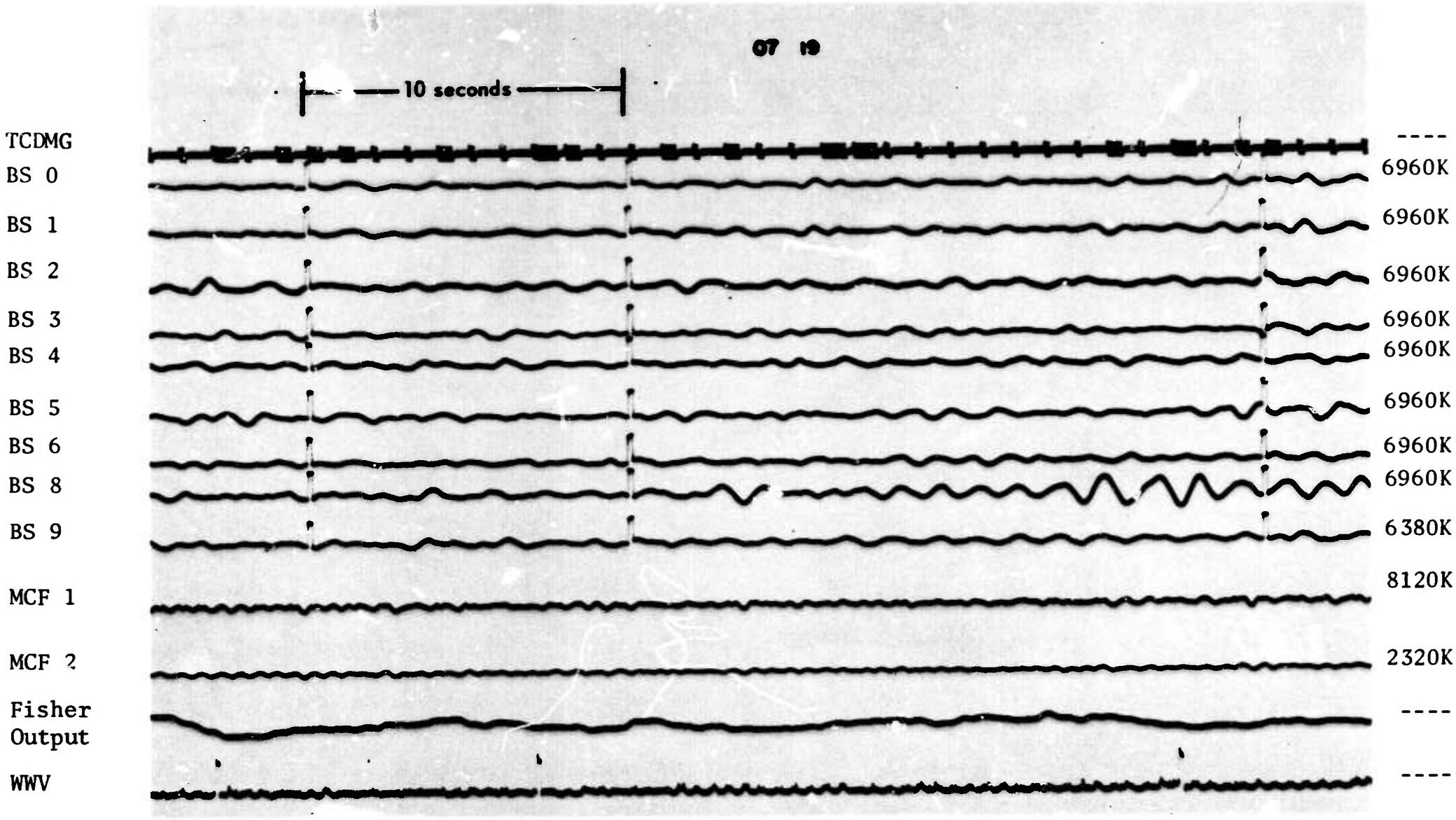
Figure 4. Short-period seismogram exhibiting response of the beam steered MCF to a low-level teleseismic event of unknown epicenter



TFSO
15 June 1970
70-166

Dev. 6
Data Trunk 4
Data Group 7296

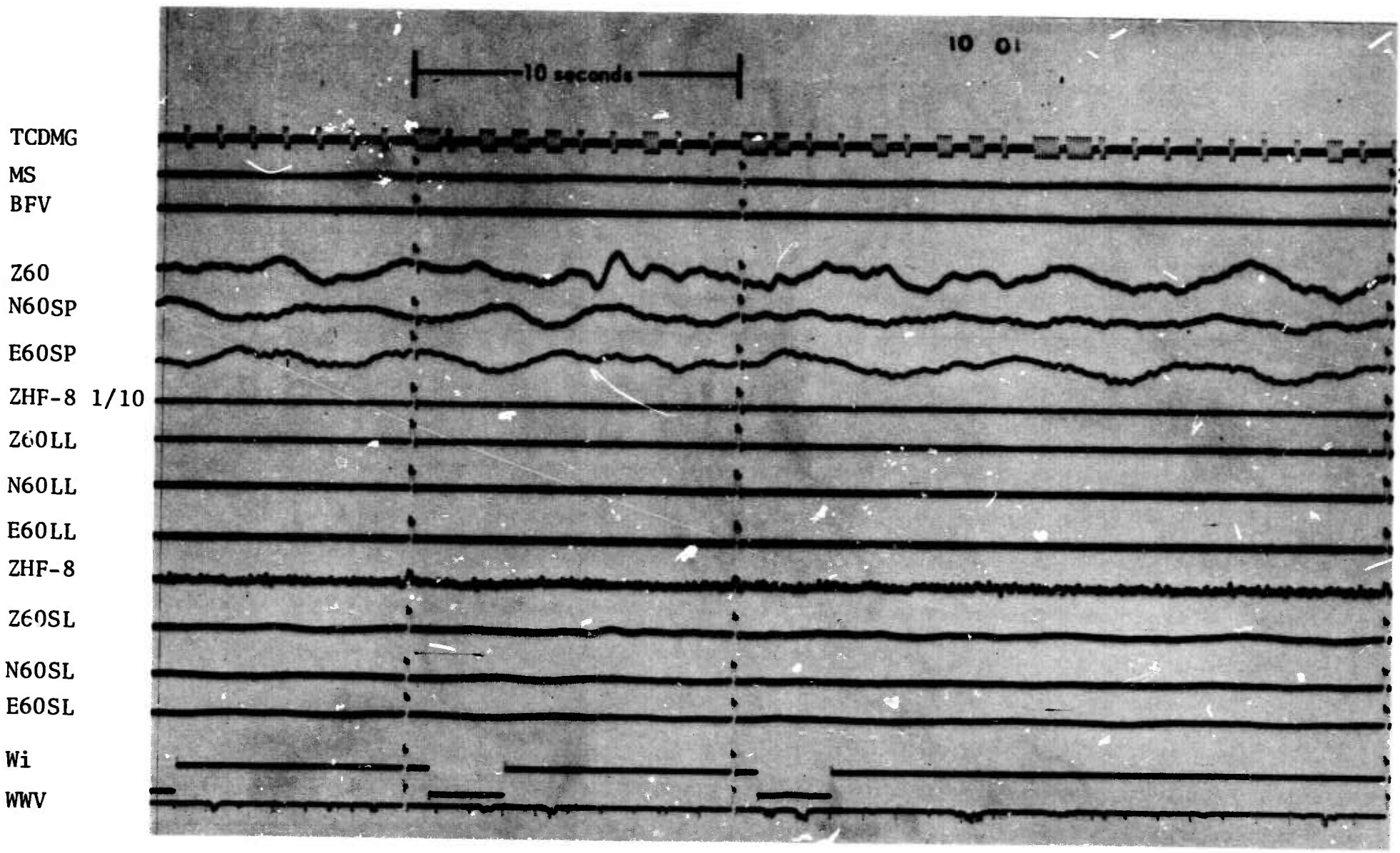
Figure 5. Short-period seismogram exhibiting response of SPZ60 seismograph to a low-level teleseismic event of unknown epicenter



TFSO
15 June 1970
70-166

Dev. 7
Data Trunk 6
Data Group 7294

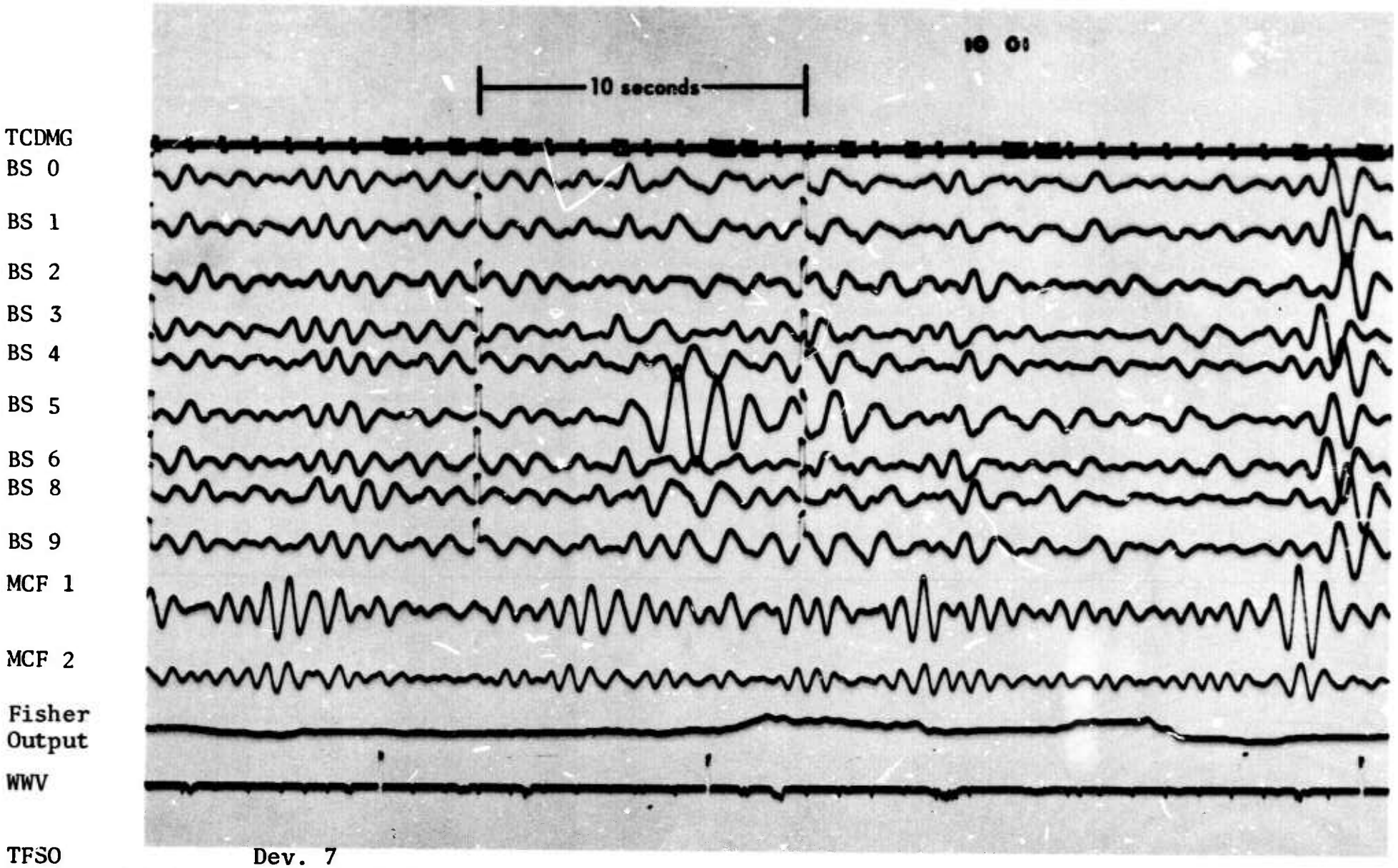
Figure 6. Short-period seismogram exhibiting response of the beam steered MCF to a low-level teleseismic event of unknown epicenter



TFSO
15 June 1970
70-166

Dev. 6
Data Trunk 4
Data Group 7296

Figure 7. Short-period seismogram exhibiting response of SPZ60 seismograph to a low-level teleseismic event of unknown epicenter



TFSO
15 June 1970
70-166

Dev. 7
Data Trunk 6
Data Group 7294

Figure 8. Short-period seismogram exhibiting response of the beam steered MCF to a low-level teleseismic event of unknown epicenter

5.6 VISITORS

5.6.1 Teledyne Visitors

Mr. B. B. Leichliter, Geotech Program Manager, visited TFSO 06 through 08 April to discuss observatory work planned for the year.

Mr. Martin Gudzin, Geotech Program Engineer, visited TFSO 01 through 04 June 1970. Mr. Gudzin accompanied the Project Officer and discussed operations and proposed tasks during his visit.

Mr. Harvey Downing, Geotech Engineer, was at TFSO 05 through 19 June 1970 to modify the Digital Data Acquisition System received from UBSO.

5.6.2 Visits by VELA Seismological Center Personnel

Major Arthur Carnevale and Lieutenant John Fergus, VSC Project Officers, visited TFSO 01 through 04 June 1970 to discuss observatory work and proposed tasks for the year.

5.6.3 Others

Mr. Ben Lucart, DCASD, Phoenix, Arizona, visited TFSO on 30 April to represent the DCASD office as a witness to opening of bids for salvage material (Spiral-4 cable).

Mr. Ralph Gilman, California Institute of Technology, visited TFSO on 25 June 1970 to discuss plans for installing their long-period system at TFSO.

6. RESEARCH PROGRAMS

6.1 MULTICHANNEL FILTER SYSTEM (MCF)

The MCF operated routinely throughout the report period.

At the request of Dr. Blandford, a new MCF program for producing beam steered outputs was generated and was used routinely starting 08 April 1970 with Data Format 7291, which follows:

MCF Data Format 7291
08 April through 30 May 1970

Channel identification	Azimuth from TFSO	Distance from TFSO	Approximate location	Apparent velocity (km/sec)
BS 0	0	30	Reliance, Canada	12.33
BS 1	90	30	Bahama Islands	12.33
BS 2	180	30	South of Revilla Gigedo Island	12.33
BS 3	270	30	900 mi. NW of Hawaii	12.33
BS 4	0	100	Arial Sea	24
BS 5	90	100	Ascension Island	24
BS 6	180	100	Reacock Sd. Antarctica	24
BS 7	270	100	Admiralty Island off New Guinea	24
BS 8	ALL	180	East Crozet Basin	Infinite
MCF 1 Fisher	315	70	Kurile Islands	18
ΣTFK	-	-	- - - - - -	-
WWV	-		- - - - - -	-

The Develocorder recording format was not changed as the trace assignment remained the same.

Later, the MCF was again reprogrammed at the request of Dr. Blandford, and was used routinely starting 01 June 1970 using Data Format 7293, which follows:

MCF Data Format 7293
01 June 1970 to Present

Channel identification	Azimuth from TFSO	Distance from TFSO	Approximate location	Apparent velocity (km/sec)
BS 0	353.8	97	Semipalatinsk, Russia	24.2
BS 1	345.6	104.2	Lop Nor, China	25.2
BS 2	209.3	61.8	Society Island, South Pacific	16.6

MCF Data Format 7293, continued

Channel identification	Azimuth from TFSO	Distance from TFSO	Approximate location	Apparent velocity (km/sec)
BS 3	29.1	61	Reykjanes Ridge, North Atlantic	16.4
BS 4	311.1	51	Rat Island, Aleutian Is.	14.5
BS 5	ALL	180	East Crozet Basin	Infinite
BS 6	0	70	Novaya Zemlya	18
BS 8	270	70	Marshall Islands	18
BS 9	315	70	Kurile Islands	18
MCF 1	315	70	Kurile Islands	18
Fisher	315	70	Kurile Islands	18
ΣTFK	-	-	- - - - - -	-
WWV	-	-	- - - - - -	-

From 26 June through 02 July, the Fisher processor and all MCF beams were steered to Novaya Zemlya. A delta of 70 degrees, an azimuth of 0 degrees, and a velocity of 18 km/sec were used. This test was conducted to collect data from an aseismic area for Dr. Blandford.

6.2 EXTENDED LONG-PERIOD SEISMOGRAPHS

The experimental long-period seismographs ZXLP and ZYLP were operated routinely throughout the report period.

6.3 NITROGEN-FILLED LONG-PERIOD TANK VAULTS

The nitrogen-filled tank vault test was continued during this report period. During April, the vaults were opened for maintenance and some moisture was found in the vaults; however, the gauge measuring the pressure was found to be faulty and it is suspected that a 1 psi pressure had not been maintained. The test was resumed again on 16 April using an accurate gauge. The usage rate of nitrogen from 16 April through 29 May was 1.36 cu. ft. per day.

The nitrogen was rechecked on 08 June and was found to be empty. It is suspected that the N7LP vault leaked after maintenance was performed on the system 04 June.

6.4 FIVE-ELEMENT SHALLOW-WELL ARRAY

At the request of the Project Officer, sites were selected and plans were made for drilling shallow wells for a 5-element array. Drilling and installation of equipment has been delayed while awaiting results of feasibility studies that use simulation techniques and are being conducted in Garland.

6.5 EXPERIMENTAL DEVELOCORDER PUMP, MODEL 30082

The experimental Develocorder pump operated throughout the report period with one failure occurring in April.

6.6 MODIFICATION OF DATA RANGE MANAGEMENT DIGITAL DATA ACQUISITION SYSTEM

Work was started in June to modify the acquisition system received from UBSO so that analog data from 21 long-period channels can be recorded digitally, utilizing equipment installed in the CRB.

6.7 EVALUATION OF NEW FILM FOR DEVELOCORDER

A new Eastman Kodak film, No. 2496-137-04, Spec. 440, with an Estar base, was tested on Develocorders running under normal operating conditions. Results of these tests will be submitted in a separate report.

6.8 VAULT RETROFIT

During May, work was begun to modify and improve the moisture seal of the N2LP vault. This is part of a continuing effort to reduce the noise level of the long-period horizontal systems. After the pier was reconstructed and the sealing method was changed, the north instrument was reinstalled and oriented as an east-west system for comparison to E2LP. Preliminary observations indicate some improvement in the noise level of the modified vault. An evaluation report will be submitted upon completion of the test.

APPENDIX to TECHNICAL REPORT NO. 70-27

STATEMENT OF WORK TO BE DONE

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3 OCT 1969

STATEMENT OF WORK TO BE DONE
(AFTAC Project Authorization No. VELA T/0704/S/ASD) (32)

Tasks:

a. Operation.

(1) Continue operation of the Tonto Forest Seismological Observatory (TFSO), normally recording data continuously.

(2) At the beginning of the project, the required level of effort at the station will be approximately the same as the final level on Project VT/9702. By the end of calendar year 1970, routine operational requirements and support of developmental tasks will have been reduced to 50 percent, and by 1 Jul 1971, these requirements will have been further reduced to 20 to 25 percent of initial level.

(3) For the 12-month period from 1 Jan through 31 Dec 1970, conduct routine daily analysis of seismic data at the observatory and transmit daily seismic teletype reports to the US Coast and Geodetic Survey, Environmental Science Services Administration, Washington Science Center, Rockville, Maryland, using the established report format and detailed instructions.

(4) The contractor shall provide for the transmission to and recording at TFSO of strain data from the VELA Long-period strain project. This will entail a leased telephone line and installation of a GFP Zipagram system.

(5) Quality control and evaluate the seismic data to determine optimum operational characteristics and make changes in the operating parameters as may be required to provide the most effective observatory practicable. Addition and modification of instruments are within the scope of work; however, such instrument modifications and additions, data evaluation, and major parameter changes are subject to the prior approval of the Government. Included in this task will be evaluation of data processing procedures using the multichannel filter processor; signal processing, recording, and transmission system; and any other designated systems as directed by the Government.

(6) Provide observatory facilities and seismological data to requesting organizations and individuals after approval by the Government.

(7) Maintain, repair, protect, and preserve the facilities of TFSO in good physical condition in accordance with sound industrial practice.

b. Instrument Installation and Evaluation. On approval by the Government, install and evaluate the performance characteristics of experimental or off-the-shelf equipment offering potential improvement in the performance of observatory seismograph systems. Operation and test of such instrumentation under field conditions should normally be preceded by laboratory test and evaluation.

c. Station Modification. As directed by the Government, incorporate new equipment into the system at TFSO. Removal of equipment should also be included in this task. Specific jobs under this task which shall be undertaken are:

(1) Install within the TFSO array the Model 30000 Observatory equipment consisting of seven long-period instruments and 13 short-period instruments with their accompanying electronics presently at Wichita Mountains Seismological Observatory (WMSO).

(2) Install radio links between six of the 30000 Observatory long-period sites (which should closely coincide with the present ring of long-period sites at TFSO) and the central recording station for transmission of data.

(3) Drill and case with 5-inch J55 casing 13 holes for installation at TFSO of Model 23900 instruments from the WMSO 30000 Observatory to a minimum depth of 10 feet below weathering or 10 feet into competent rock, whichever comes first. Install the instruments in the holes.

(4) Install a Government-furnished Zipagram system (12 channels) for multiplexing TFSO data to a central recording & processing facility.

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13. ABSTRACT

This is a report of the work accomplished on Project VT/0704 from 1 April through 30 June 1970. Project VT/0704 includes the operation, evaluation, and improvement of the Tonto Forest Seismological Observatory (TFSO) located near Payson, Arizona. It also includes special research and test functions carried out at TFSO and research and development tasks performed by the Garland, Texas, staff using TFSO data.

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Short-Period Array						
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